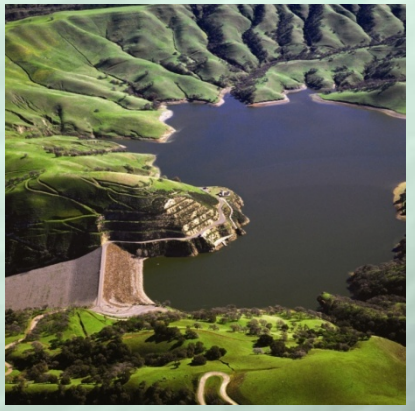

Evaluating Resource Management Strategies For the California Water Plan

Update 2013
California Water Plan

Rich Juricich,
California Department of Water Resources

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- Dr. David Yates, National Center for Atmospheric Research

Managing an Uncertain Future

Risk, Uncertainty, and Sustainability

Water Policy Questions Addressing a Changing Climate

- What is the range of potential future climate between now and 2050? What are the ranges of other key uncertainties (demographics, land-use) over the same time period.
- How does a changing climate effect policy outcomes? To what climate conditions is the system vulnerable?
- How can different water management strategies and response packages increase resilience to changing climate?
- What are the key tradeoffs among different strategies?

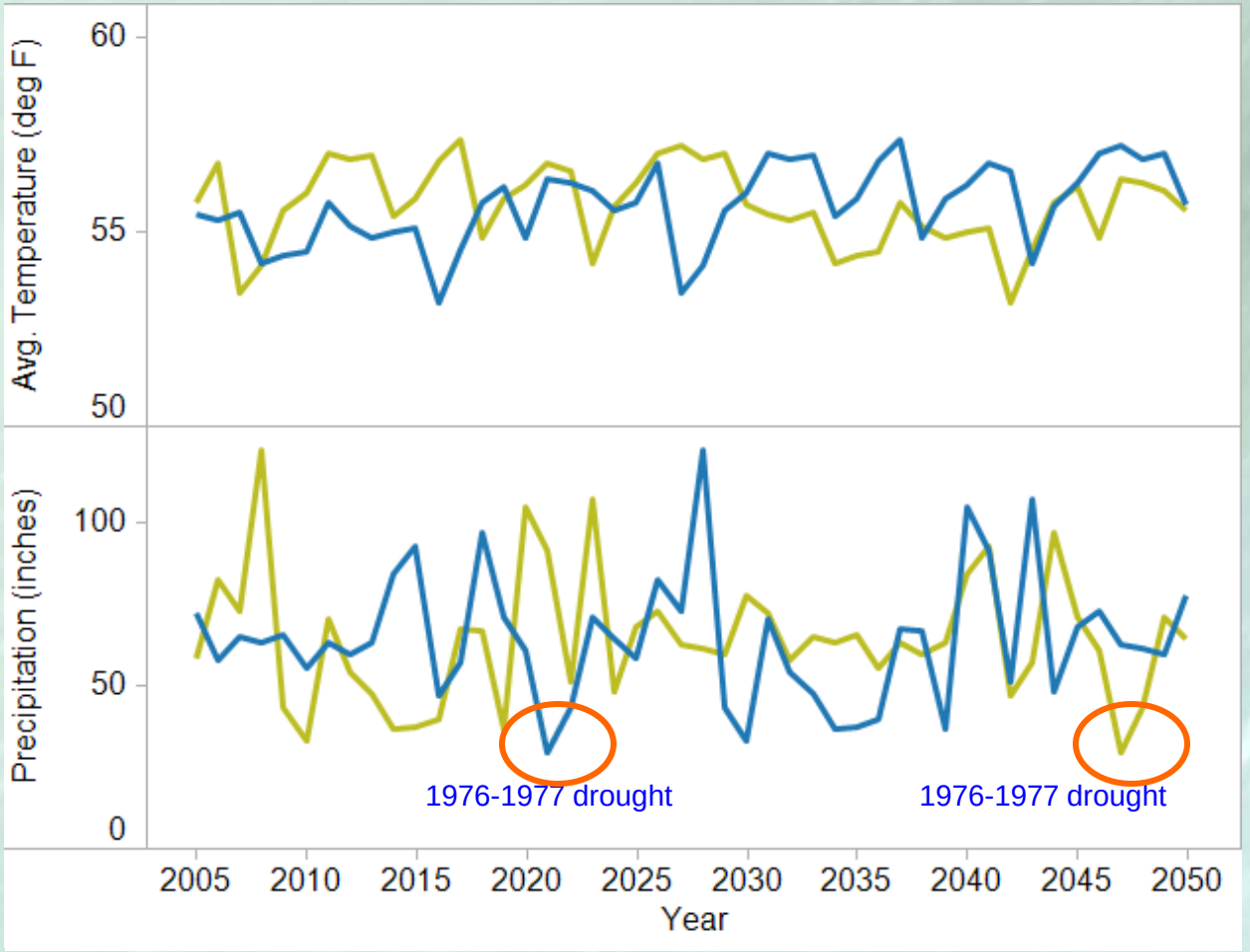
Plan of Study Components

Uncertain Factors (X) and Scenarios	Management Strategies (L) and Response Packages
• Climate • Population • Employment • Housing density	Current Management Additional strategies • Agricultural water use efficiency • Urban water use efficiency • New surface storage • Conjunctive management & groundwater storage • Recycled municipal water • Meeting additional flow targets and groundwater recovery goals
Models (R)	**Performance Metrics (M)**
• UPLAN • SWAP • Statewide Model • Central Valley Model	• Urban Supply Reliability • Agricultural Supply Reliability • Reliability of instream flow requirements and targets • Groundwater levels

System is Evaluated Against an Ensemble of Future Climate Scenarios

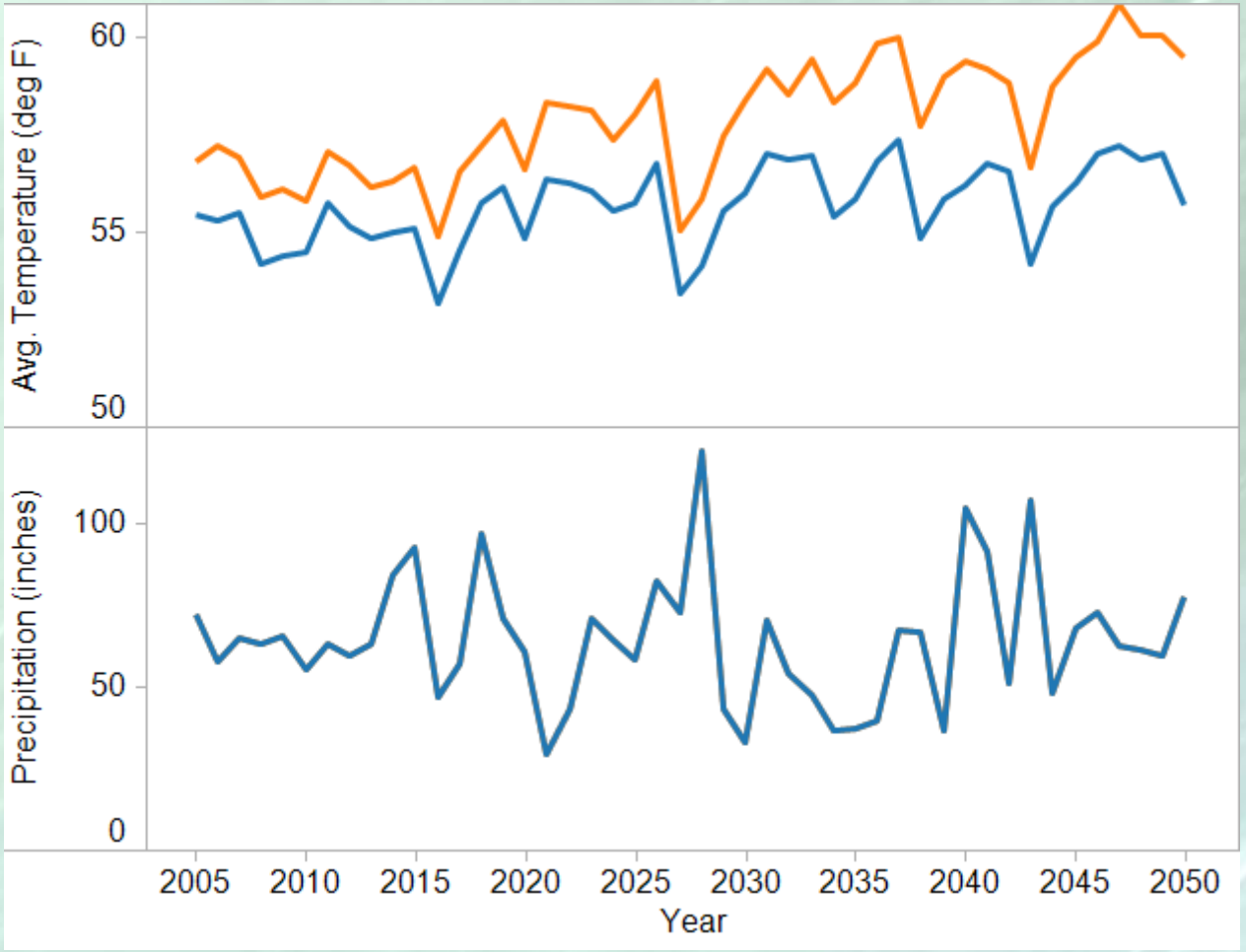
- Repeat of historical climate patterns
- Historical climate patterns with intensified drought
- Historical climate patterns with increasing temperature trend
- Downscaled global climate models

Five Offsets of Historical Climate Build Understanding of Vulnerability to Timing Of Droughts



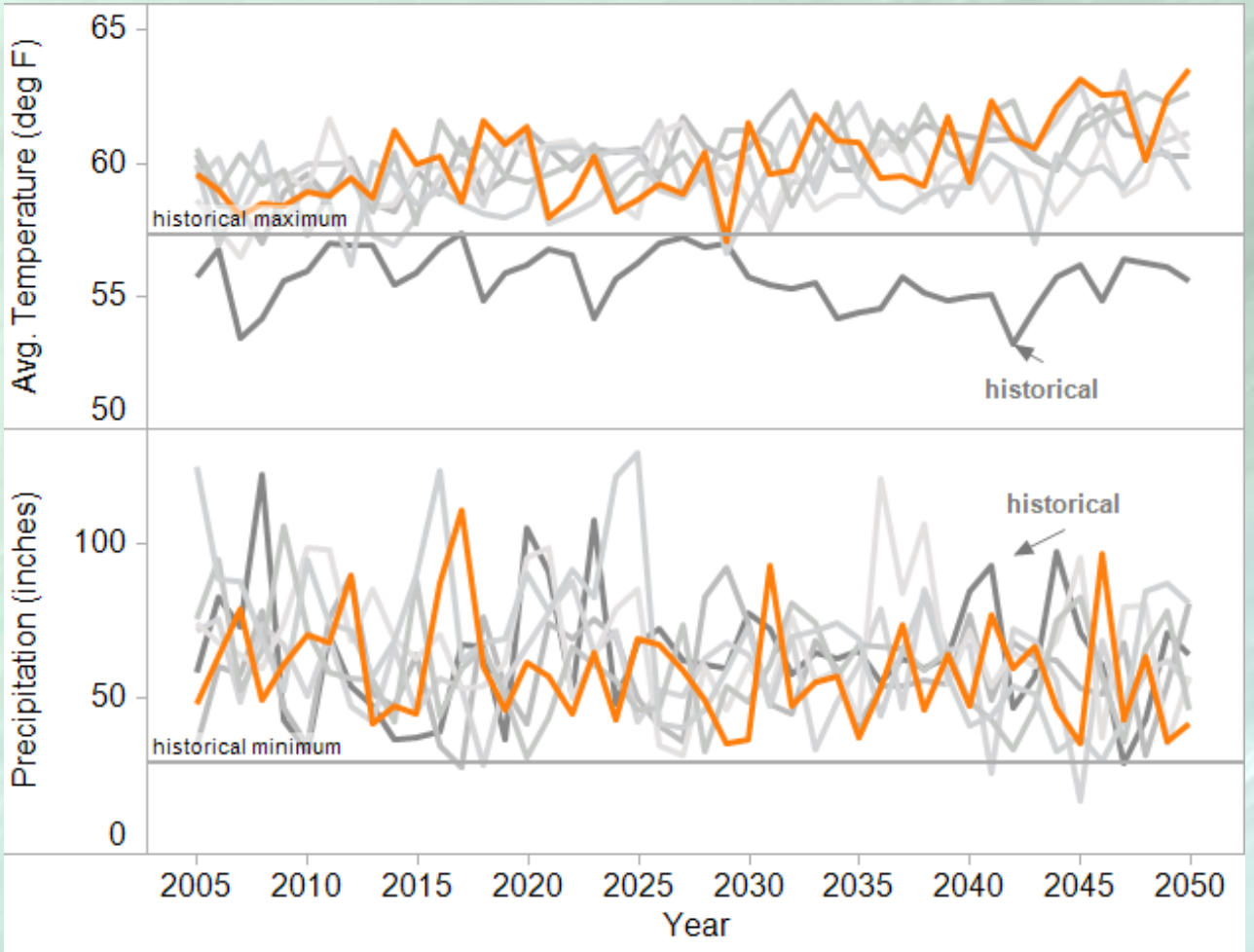
5 offsets evaluated

Overlaying Temperature Trend Isolates Effects of Warming Climate



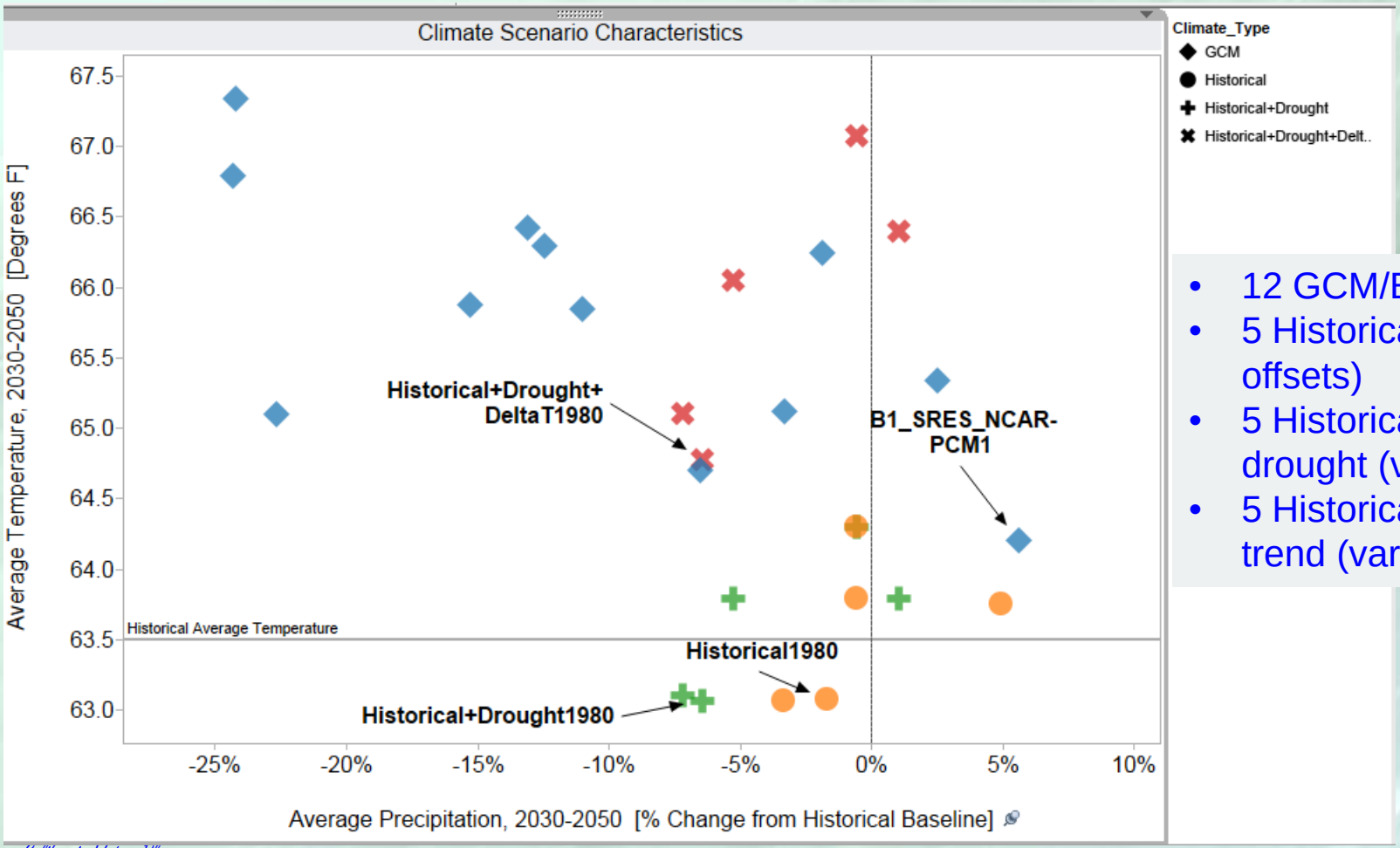
Average Warming by 12 climate models

Downscaled Climate Simulations Reflect Uncertainty in Future Climate Forecasts



Showing projections from 6 of 12 climate simulations

Ensemble of Climate Scenarios Represents Wide Range of Potential Futures



- 12 GCM/BCSD derived
- 5 Historical (various offsets)
- 5 Historical w/ long drought (various offsets)
- 5 Historical w/ temp trend (various offsets)

Water Management Models Evaluate System Across Many Scenarios

Statewide Model

- Statewide
- Evaluation of monthly water demands by hydrologic region
- Reflect demographic and climate uncertainty

Central Valley Model

- Sacramento, San Joaquin, and Tulare Lake hydrologic regions
- Simulation of monthly demand, supplies, and management under uncertainty
- Evaluation of water management strategies

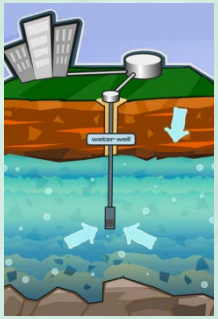
Both models built in user-friendly modeling environment to support collaboration

Central Valley Model Estimates Future System Performance

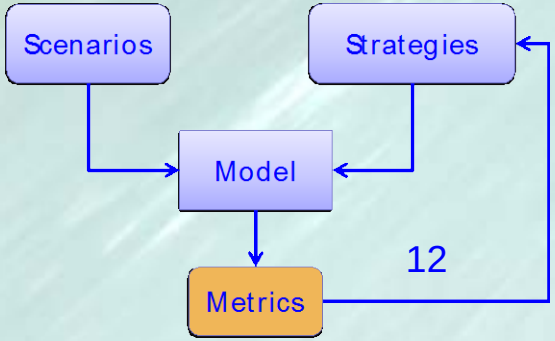
- Urban unmet demand
  - Reliability
  - Magnitudes of shortages

- Agricultural unmet demand
  - Reliability
  - Magnitudes of shortages

- Environmental performance
  - Reliability of meeting In-stream Flow Requirements

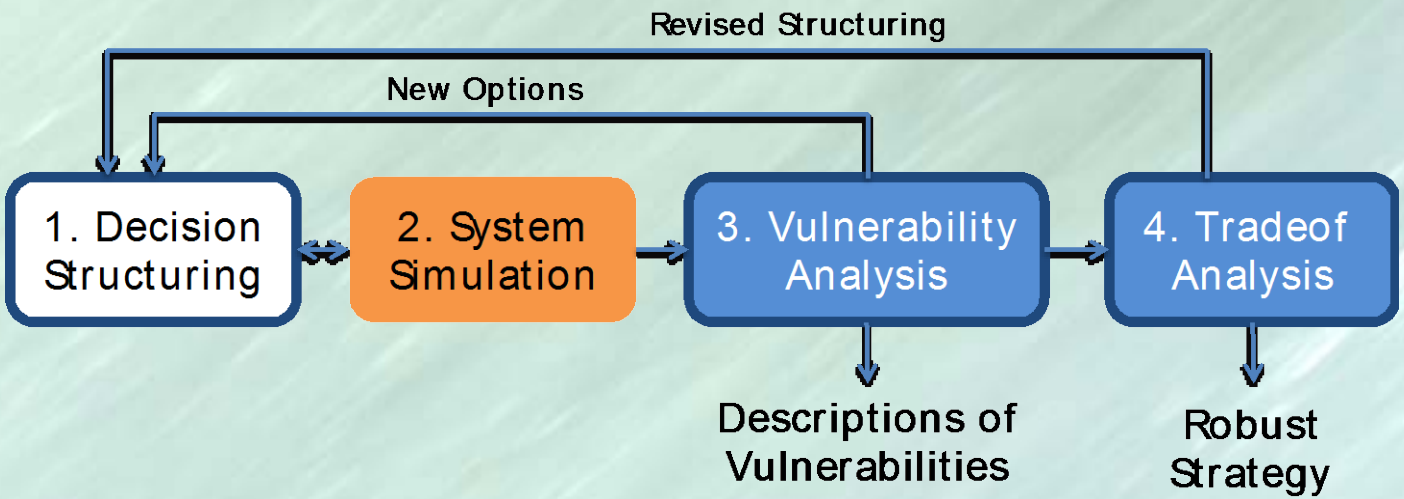


- Groundwater storage
  - Change over time

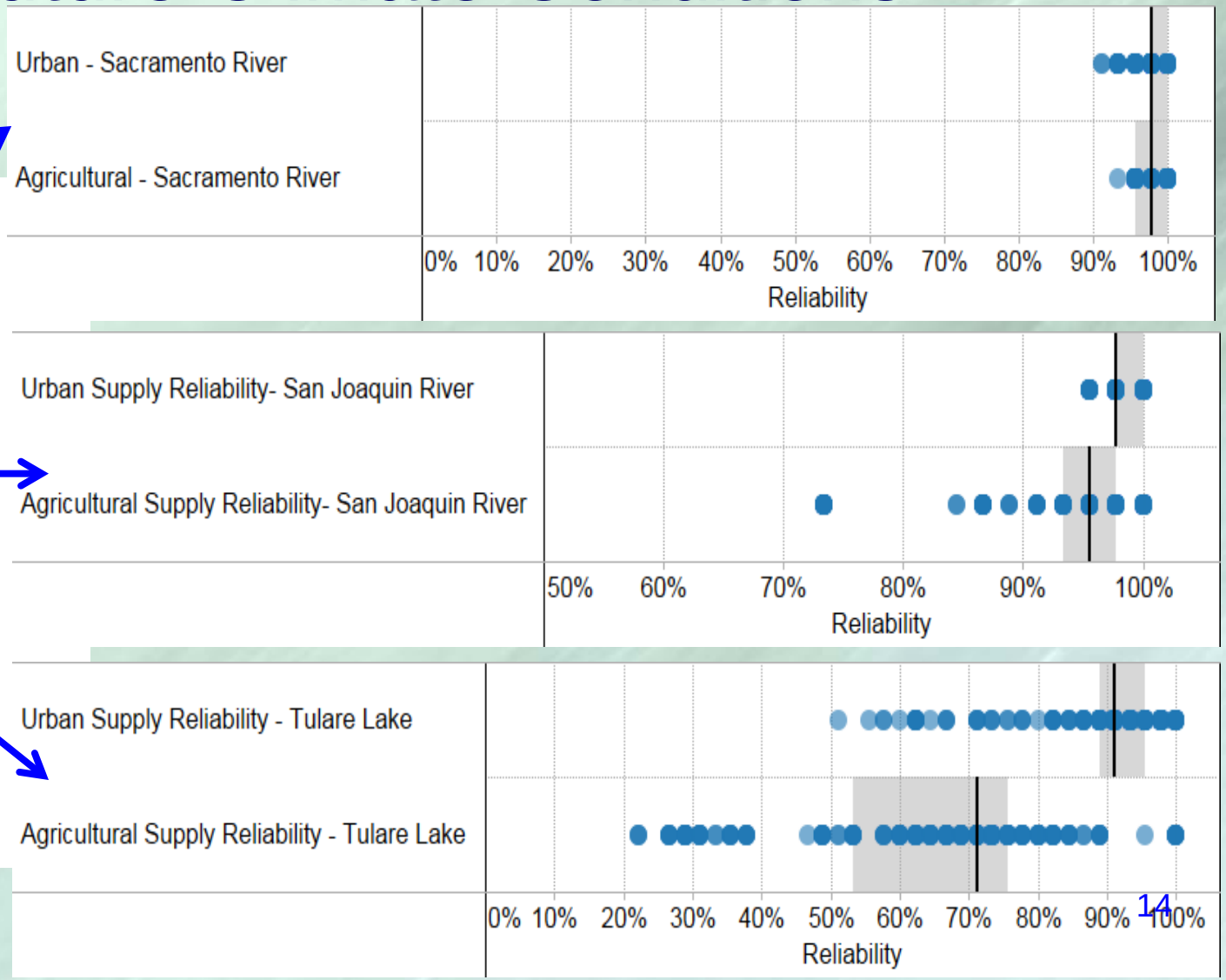


Current Management System Evaluated Under Many Plausible Futures

Growth Scenarios		Climate Scenarios		Total Futures
3 population	X	5 Historical ISM	=	243
		5 Historical Drought		
3 urban densities		5 Historical Drought + Steady Warming		
		12 Downscaled Climate Model		

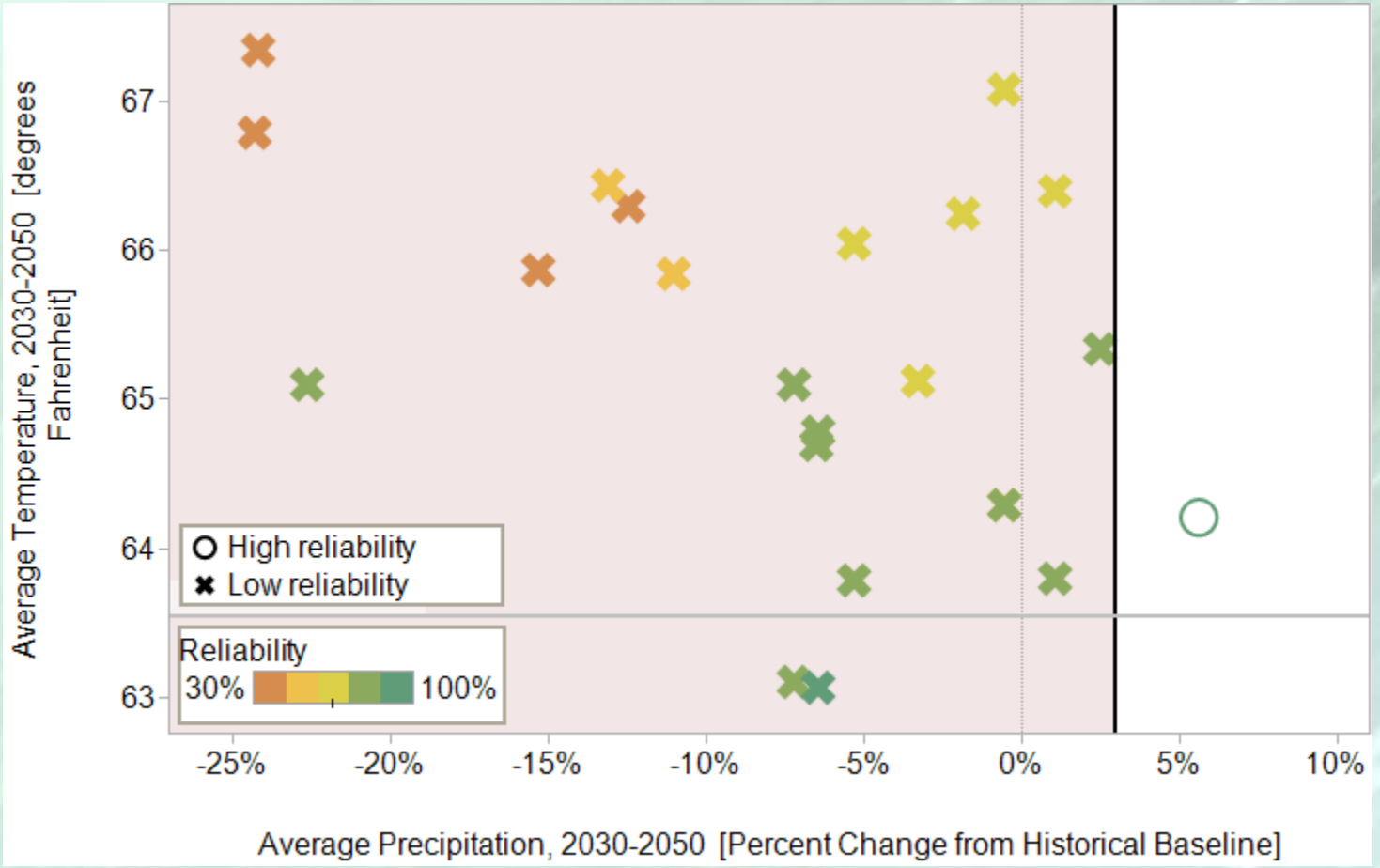


Range of Supply Reliability Under Current Management Varies Across Future Climate Conditions



Agricultural Reliability in San Joaquin HR Vulnerable to Warming and Drying Future Conditions

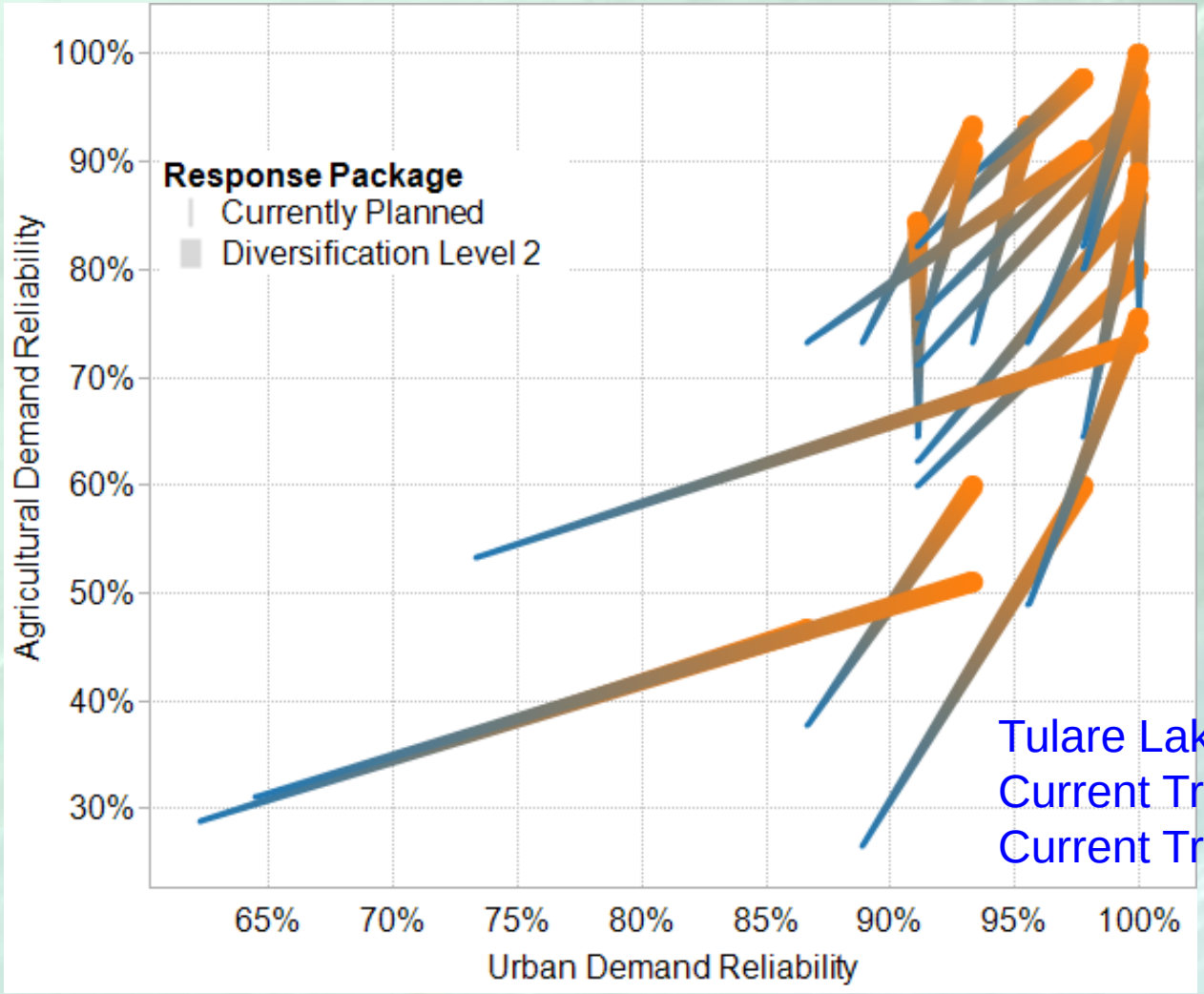
Agricultural Reliability in Tulare Lake HR Vulnerable to All But Wettest Climate Scenario



Key Results from Vulnerability Analysis

- Sacramento River hydrologic region generally resilient to range of climate futures
- The San Joaquin River hydrologic region vulnerable to warming and drying conditions.
- Tulare Lake hydrologic region agriculture vulnerable to all but the wettest futures
- Groundwater conditions vulnerable to similar conditions

Increased Agriculture and Urban Water Use Efficiency Improves Outcomes, Even in Most Challenging Futures

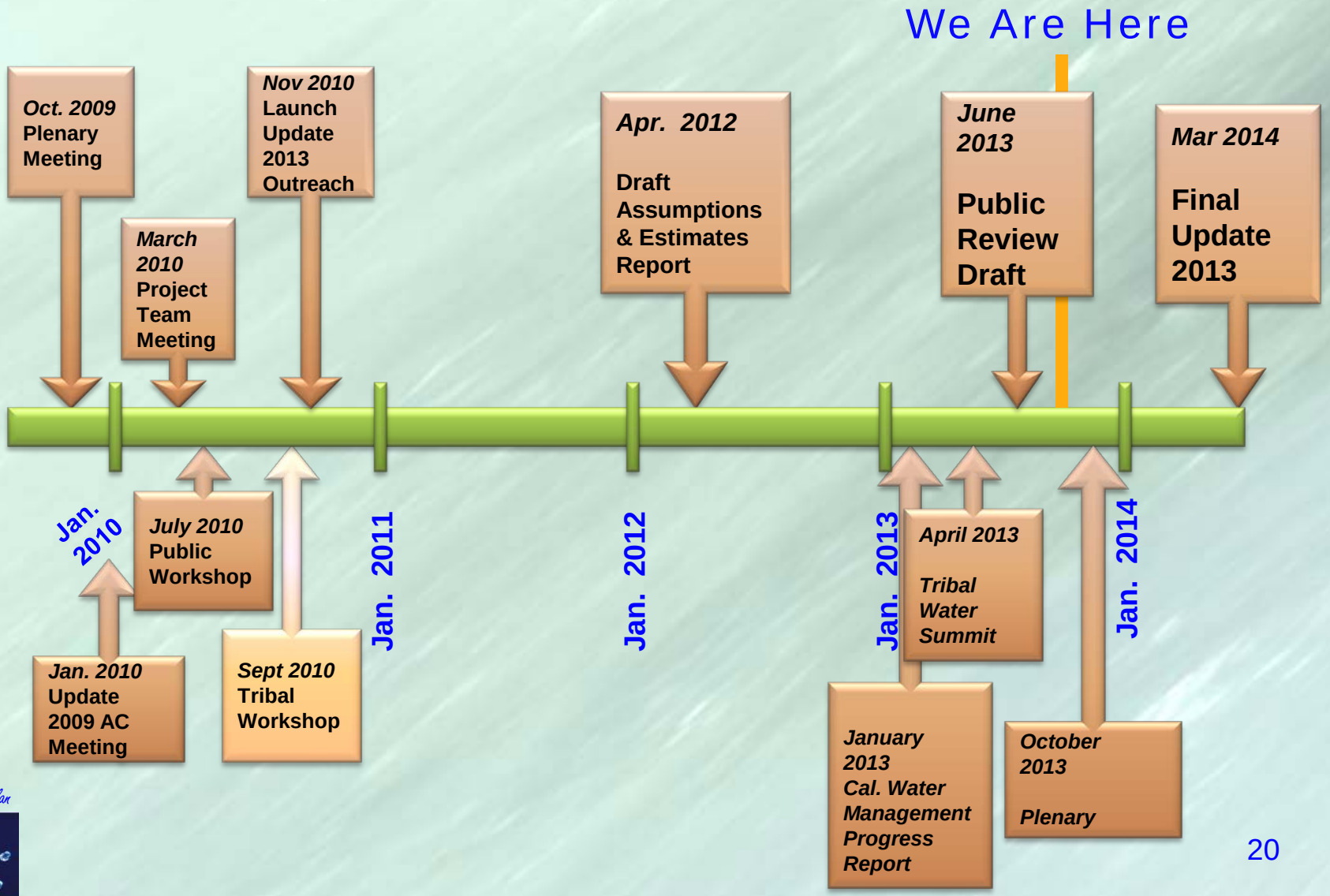


Tulare Lake HR
Current Trends Population
Current Trends Density

Continuing Analysis Evaluates Response Packages

- Evaluates ability of alternative portfolios management strategies to add resilience to the system
- Compares performance of response packages under most stressing climate conditions
- Considers tradeoffs between robustness and cost

Revised Update 2013 Scoping & Deliverables



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